Hipotronics®

PESCHEL™ AUTOMATIC VOLTAGE REGULATOR

Designed to meet your service line requirements from 240 V to 13.8 kV, 40 amps to 2000 amps

APPLICATIONS: Broadcast • Computer • Industrial • Commercial • Medical • Shore-to-Ship Power • Line Drop Compensation • Lighting • Energy Management Systems

PESCHEL™ AUTOMATIC VOLTAGE REGULATOR

The Peschel™ Automatic Voltage Regulator is a 50/60 Hz., wye connected, dry-type, convection cooled, ac line voltage regulator. It is designed to maintain line voltage to within ±1% of nominal, with an input voltage variation of +9/-14% or ±20%, due to line and/or load changes. The PAVR introduces no harmful waveform distortion, has a very low internal impedance, causes no phase shift, is insensitive to load power factor, has no effect on system power factor, and is approx. 99% efficient.

The PAVR is neither an impedance changing nor a ferroresonant device and uses no SCRs. It is an electro-mechanical device using electro-magnetic transformer action to regulate. Its high efficiency and reliability make it the best solution to today's voltage problems.

Since the advent of the PAVR, there is finally a voltage regulator that incorporates the variable transformer/ buck-boost transformer method of voltage regulation used for over fifty years, and is designed for standard service line voltages and currents.

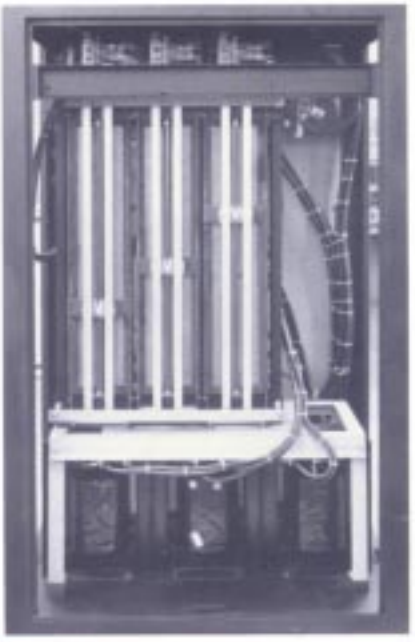
The PAVR is designed for applications that do not require instantaneous voltage correction. Other regulators that correct instantly sacrifice efficiency, size, weight, output accuracy, serviceability, and are often waveform distorting and expensive. Know your requirements.

The PAVR is the choice for non-instantaneous voltage correction in applications above 40 amperes.

DESIGN

Most PAVRs use a buck/boost transformer controlled by a Peschel™ Variable Transformer and an electronic voltage sensing circuit to provide constant output voltage. The variable transformer is connected across the line. The secondary of the buck/boost transformer is connected in series with the line. Its primary is connected to the variable transformer's output and fixed tap (fig. 1). When the electronic controls, connected across the output of the regulator, sense a voltage change that is greater than the preset tolerance of the regulator, a signal is sent to the motor drive of the variable transformer. The variable transformer will apply a voltage to the primary of the buck/boost, thereby inducing a voltage in the secondary. The secondary either adds or subtracts voltage from the line depending upon the polarity of the primary. The polarity of the primary is determined by the position of the variable transformer's sliding contact with respect to its fixed tap.

PAVRs rated 100 amps and below do not use a buck/ boost transformer. Since the PVT is capable of commutating up to 120 amps, a limited range output PVT is used. See figures 1, 3 & 4, page 4.



Inner view showing the patented Peschel™ Variable Transformer

THE PESCHEL DIFFERENCE

Most of our regulators incorporate the patented PESCHEL™ VARIABLE TRANSFORMER. The PVT is a continuously adjustable autotransformer. Its patented commutation technique has eliminated the shorted turn problem of conventional variable transformers.

Conventional variable transformers use a carbon brush to traverse a coil face to provide variable voltage. As the carbon brush traverses the coil face it short circuits adjacent turns. The shorted condition produces circulating current in the brush and shorted wire loop. This current must be limited so as not to produce excessive heating of the brush and coil. This inherent design flaw severely limits the capability of these devices. For use in a regulator of some power, many of these variable transformers must be paralleled, thus increasing the size and weight and decreasing the reliability. The elimination of short-circuited turns with the PVT is achieved by connecting back-to-back silicon diodes between the sliding contacts of the two commutator paths of the same coil (see figure 1). Using the diodes for their forward voltage drop (FVD) and maintaining tranformer volts per turn less than the total FVD, essentially no current can circulate between contacts. With no short-circuit current to limit, or heat to dissipate, almost any kVA size is possible using only one core/coil assembly, resulting in a variable transformer, hence regulator, that is smaller, lighter, more efficient, easier to service, and more reliable than all others. (Send for PVT brochure.)

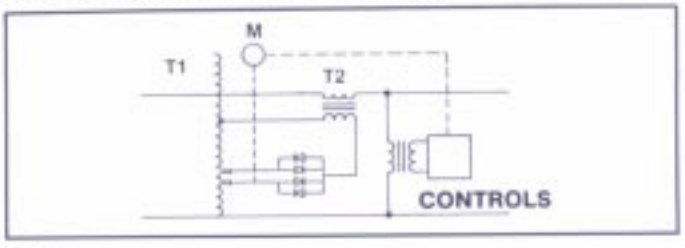


Fig. 1

SPECIFICATIONS

- **99% EFFICIENT**
- **NO WAVEFORM DISTORTION**
- **VERY LOW INTERNAL IMPEDANCE**
- **NO PHASE SHIFT**
- **NO EFFECT ON POWER FACTOR**
- **UP TO 20 VOLTS PER SECOND CORRECTION RATE**
- **TEMPERATURE RANGE -10° C to +50° C**
- **OUTPUT ACCURACY ±1% ADJUSTABLE TO ±5%**
- **VOLTMETER WITH EXPANDED SCALE**
- **DRY TYPE, CONVECTION COOLED**

FEATURES

VOLTAGE MONITOR RELAY - Every 3-phase PAVR is equipped with a voltage monitor relay which is capable of sensing undervoltage, overvoltage, and loss-of-phase conditions. This relay will disable the motor drive on the variable transformer until proper voltage conditions have been restored. This prevents the application of a dangerous voltage to the load in the event of a loss of feedback or operator error.

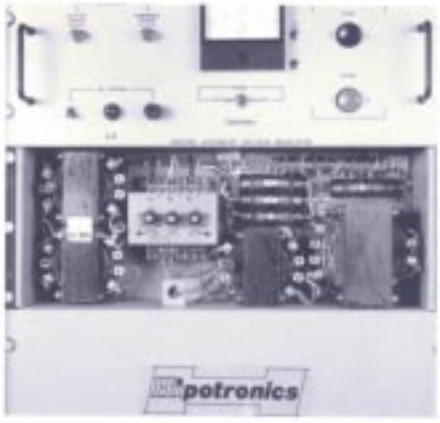
RMS CONVERTER - The electronic control circuitry used in the PAVR includes a true RMS to DC converter, which provides the output voltage analog to both the front panel voltmeter and the comparator circuitry. This minimizes the effects of waveform distortion or noise on the incoming power line and the resulting inaccuracies in output voltage level.

OPTIONS

INDIVIDUAL PHASE CONTROL:
This option allows a three-phase regulator to compensate for unbalanced phase voltages as well as overall under and overvoltage conditions. The voltage of each phase is sensed from line to neutral, and corrections are made independent of the other phases. Three complete sets of automatic controls are provided, each with the same features and controls used on the standard models. Individual phase control is only suitable for use on 4 wire, WYE connected power systems where the neutral is available for connection to the regulator.

This option should be specified when considering a regulator for loads that are particularly sensitive to voltage imbalance.

BYPASS SWITCH:
The bypass switch is used to disconnect both the input and the output of the regulator from the line, while still providing power to the load. It is a very convenient means of de-energizing the regulator with only a momentary interruption in load power, and greatly facilitates service and maintenance of the regulator. The switch is typically a six pole, double throw rotary type mounted within the regulator enclosure (see photo). This option is recommended for critical applications



VIEW BEHIND ACCESS PANEL SHOWING VOLTAGE MONITOR RELAY AND CONTROL TRANSFORMERS

BY-PASS SWITCH SHOWN MOUNTED IN REGULATOR ENCLOSURE

where an interruption in load power for periodic maintenance cannot be tolerated.

LINE DROP COMPENSATION:
This option allows the regulator to compensate for the voltage drop in long cable runs between the regulator and the load. Line drop compensators will usually have several settings for various lengths of cable, and will vary the amount of compensation according to the load current. It is recommended for cases where the regulator must be located at some distance from the load.

ALSO AVAILABLE:
Special enclosures for outdoor use or hostile environments can be provided, as well as heavy-duty enclosures for portability.

Metering options, including input voltmeters, ammeters, digital metering.

Transient Suppression.

Overcurrent protection, such as fuses and circuit breakers.

High Voltage Regulators - 2400 V, 4160 V, 13.8 kV at power levels up to 5 MVA.

SCHEMATIC DIAGRAMS

FIG. 1 NO BUCK/ BOOST, SINGLE PHASE (100 AMPS AND BELOW)

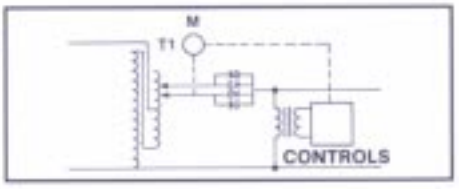


FIG. 2 BUCK/ BOOST, SINGLE PHASE (OVER 100 AMPS)

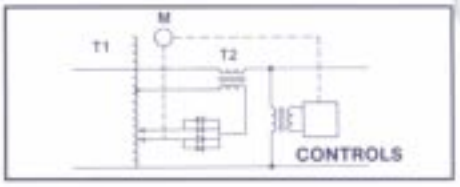


FIG. 3 NO BUCK/ BOOST, THREE PHASE WITHOUT INDIVIDUAL PHASE CONTROL

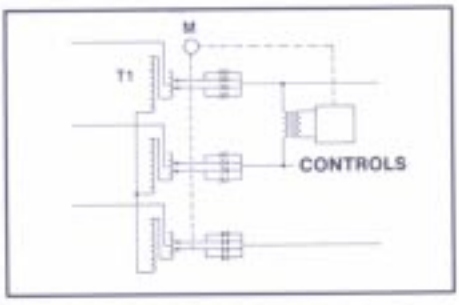


FIG. 4 NO BUCK/ BOOST, THREE PHASE, INDIVIDUAL PHASE CONTROL

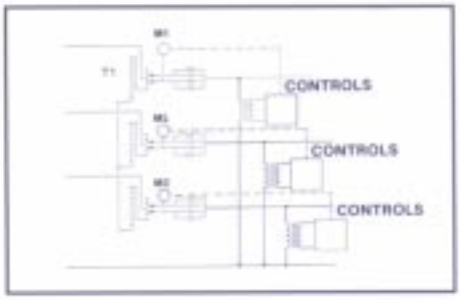


FIG. 5 BUCK/ BOOST, THREE PHASE WITHOUT INDIVIDUAL PHASE CONTROL

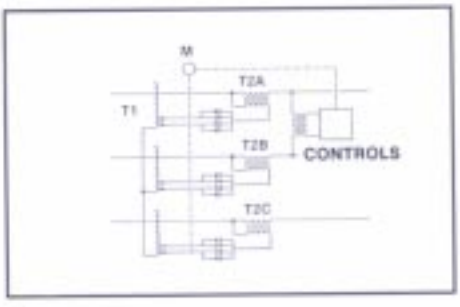
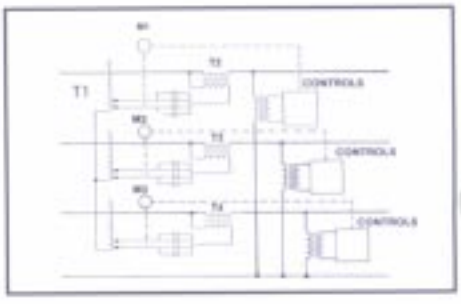
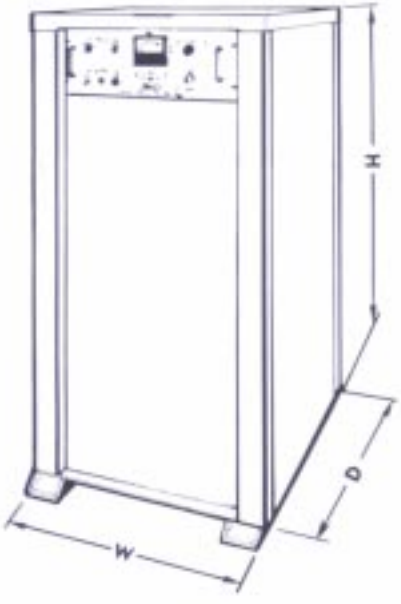


FIG. 6 BUCK/ BOOST, THREE PHASE INDIVIDUAL PHASE CONTROL



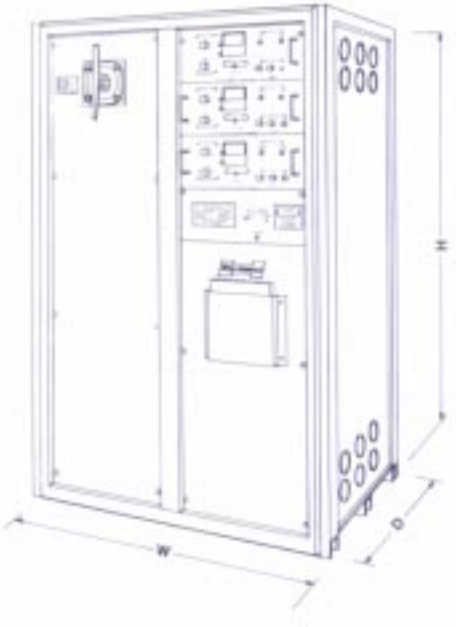
CABINET DIMENSIONS

SINGLE CABINET (A,B,C,D,)

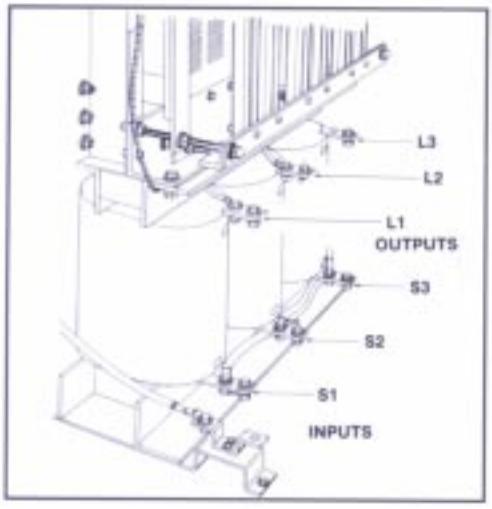


CABINET DIMENSION			
CABINET	WIDTH in (mm)	DEPTH in (mm)	HEIGHT in (mm)
A	30" (762)	25" (635)	30" (762)
B	30" (762)	25" (635)	52" (1320)
C	30" (762)	25" (635)	72" (1829)
D	30" (762)	42" (1067)	72" (1829)
E	48" (1219)	36" (914)	78" (1980)

TWO-BAY CABINET (E)



INPUT/OUTPUT CONNECTIONS



Most PAVRs that are not equipped with the optional line bypass switch have both source and load connections made directly to the bus bar terminals on the Buck/Boost transformer(s) (see drawing). Some lower current models are equipped with a terminal board.

Units equipped with the bypass switch have the source and load connections made to the switch terminals. The standard mounting location for the bypass switch in cabinets A, B, C, & D is at the upper rear of the cabinet with the handle accessible from the back of the cabinet. In cabinet E the switch is located in the upper left hand corner of the front of the cabinet (see cover photo). Buck/Boost transformers are always located at the bottom of the enclosure.

SINGLE PHASE INPUT VOLTAGE RANGE: +9%/ -14% OF NOMINAL

INPUT: 240 Volts, 220 Volts

AMPS	KVA At 240V	MODEL	CABINET	CORRECTION RATE*	WEIGHT lb. (kg)
50	12	A240-50	A	9	275 (125)
100	24	A240-100	A	9	300 (136)
150	36	A240-150	A	9	350 (159)
200	48	A240-200	B	9	380 (172)
300	72	A240-300	B	9	510 (231)
400	96	A240-400	B	9	580 (263)
500	120	A240-500	C	9	620 (281)
600	144	A240-600	C	9	750 (340)
700	168	A240-700	C	9	900 (408)

INPUT: 480 Volts

AMPS	KVA	MODEL	CABINET	CORRECTION RATE*	WEIGHT lb. (kg)
50	24	A480-50	A	18	350 (159)
100	48	A480-100	A	18	450 (204)
150	72	A480-150	A	18	600 (272)
200	96	A480-200	B	18	750 (340)
300	144	A480-300	B	18	850 (386)
400	192	A480-400	B	18	1050 (476)
500	240	A480-500	C	18	1200 (544)
600	288	A480-600	C	18	1300 (590)
700	336	A480-700	C	18	1500 (680)

SINGLE PHASE INPUT VOLTAGE RANGE: ±20% OF NOMINAL

INPUT: 240 Volts, 220 Volts

AMPS	KVA At 240V	MODEL	CABINET	CORRECTION RATE*	WEIGHT lb. (kg)
50	12	D240-50	A	15	330 (150)
100	24	D240-100	A	15	350 (159)
150	36	D240-150	B	15	400 (181)
200	48	D240-200	B	15	475 (215)
300	72	D240-300	B	15	650 (295)
400	96	D240-400	C	15	800 (363)
500	120	D240-500	C	15	825 (374)
600	144	D240-600	C	15	1000 (454)
700	168	D240-700	C	15	1200 (544)

INPUT: 480 Volts

AMPS	KVA	MODEL	CABINET	CORRECTION RATE*	WEIGHT lb. (kg)
50	24	D480-50	A	25	450 (204)
100	48	D480-100	A	25	575 (261)
150	72	D480-150	A	25	800 (363)
200	96	D480-200	B	25	925 (420)
300	144	D480-300	B	25	1000 (454)
400	192	D480-400	B	25	1450 (658)
500	240	D480-500	C	25	1590 (721)
600	288	D480-600	C	25	1700 (771)
700	336	D480-700	C	25	1900 (862)

*Approx. volts per second

Sizes and weights are subject to change. If sizes and weights are critical, request drawing from factory.

THREE PHASE
INPUT VOLTAGE RANGE: +9%/ -14%
OF NOMINAL

NOTE: "Z" at the end of the model number indicates a PAVR with Individual Phase Control

INPUT: 240 Volts, 220 Volts, 208 Volts

Correction rate approx. 10 volts/sec.

AMPS	KVA At 240V	MODEL	CABINET Y	CABINET YZ	WEIGHT Y lb. (kg)	WEIGHT YZ lb. (kg)
40	17	A240-40Y(Z)	A	B	320 (145)	470 (213)
60	25	A240-60Y(Z)	A	B	510 (231)	550 (250)
100	42	A240-100Y(Z)	B	B	550 (250)	600 (272)
150	62	A240-150Y(Z)	B	C	720 (327)	875 (397)
200	83	A240-200Y(Z)	C	C	800 (363)	1050 (476)
300	125	A240-300Y(Z)	C	C	950 (431)	1100 (499)
400	166	A240-400Y(Z)	C	D	1150 (522)	1550 (703)
500	208	A240-500Y(Z)	C	D	1400 (635)	1725 (783)
600	249	A240-600Y(Z)	D	D	1650 (748)	1900 (862)
700	291	A240-700Y(Z)	D	D	1850 (839)	2200 (998)
800	333	A240-800Y(Z)	D	D	2100 (953)	2400 (1089)

INPUT: 415 Volts, 380 Volts

Correction rate approx. 15 volts/sec.

AMPS	KVA At 415V	MODEL	CABINET Y	CABINET YZ	WEIGHT Y lb. (kg)	WEIGHT YZ lb. (kg)
40	29	A415-40Y(Z)	A	B	400 (181)	550 (250)
60	43	A415-60Y(Z)	A	B	480 (218)	600 (272)
100	72	A415-100Y(Z)	B	B	650 (295)	700 (318)
150	108	A415-150Y(Z)	B	B	950 (431)	1100 (499)
200	144	A415-200Y(Z)	C	C	1200 (544)	1375 (624)
300	216	A415-300Y(Z)	C	D	1350 (612)	1550 (703)
400	288	A415-400Y(Z)	C	D	1500 (680)	1700 (771)
500	359	A415-500Y(Z)	D	D	1775 (805)	1950 (885)
600	431	A415-600Y(Z)	D	D	1875 (851)	2175 (987)
700	503	A415-700Y(Z)	D	E	2000 (907)	2500 (1134)
800	575	A415-800Y(Z)	E	E	2300 (1043)	2700 (1225)

INPUT: 480 Volts

Correction rate approx. 20 volts/sec.

AMPS	KVA	MODEL	CABINET Y	CABINET YZ	WEIGHT Y lb. (kg)	WEIGHT YZ lb. (kg)
40	33	A480-40Y(Z)	A	B	450 (204)	600 (272)
60	50	A480-60Y(Z)	A	B	500 (227)	700 (318)
100	83	A480-100Y(Z)	B	B	650 (295)	850 (386)
150	125	A480-150Y(Z)	C	C	1000 (454)	1200 (544)
200	166	A480-200Y(Z)	C	D	1275 (579)	1350 (612)
300	249	A480-300Y(Z)	C	D	1350 (612)	1500 (680)
400	333	A480-400Y(Z)	D	D	1450 (658)	1700 (771)
500	416	A480-500Y(Z)	D	D	1600 (726)	2100 (953)
600	499	A480-600Y(Z)	D	E	1800 (817)	2800 (1270)
700	582	A480-700Y(Z)	E	E	2300 (1043)	3000 (1361)
800	665	A480-800Y(Z)	E	E	2700 (1305)	3300 (1497)

THREE PHASE
INPUT VOLTAGE RANGE: ±20%
OF NOMINAL

INPUT: 240 Volts, 220 Volts, 208 Volts

Correction rate approx. 10 volts/sec.

AMPS	KVA At 240V	MODEL	CABINET Y	CABINET YZ	WEIGHT Y lb. (kg)	WEIGHT YZ lb. (kg)
40	17	D240-40Y(Z)	A	B	390 (177)	500 (227)
60	25	D240-60Y(Z)	A	B	550 (250)	575 (261)
100	42	D240-100Y(Z)	A	B	650 (295)	700 (318)
150	62	D240-150Y(Z)	B	C	900 (408)	1100 (499)
200	83	D240-200Y(Z)	C	C	1150 (522)	1350 (612)
300	125	D240-300Y(Z)	C	D	1300 (590)	1600 (726)
400	166	D240-400Y(Z)	D	D	1500 (680)	1850 (839)
500	208	D240-500Y(Z)	D	D	1800 (817)	2250 (1021)
600	249	D240-600Y(Z)	D	D	2200 (998)	2500 (1134)
700	291	D240-700Y(Z)	E	E	2600 (1179)	2775 (1259)
800	333	D240-800Y(Z)	E	E	2800 (1270)	3150 (1589)

INPUT: 415 Volts, 380 Volts

Correction rate approx. 15 volts/sec.

AMPS	KVA At 415V	MODEL	CABINET Y	CABINET YZ	WEIGHT Y lb. (kg)	WEIGHT YZ lb. (kg)
40	29	D415-40Y(Z)	A	B	500 (227)	550 (250)
60	43	D415-60Y(Z)	A	B	550 (250)	600 (272)
100	72	D415-100Y(Z)	B	B	750 (340)	850 (386)
150	108	D415-150Y(Z)	B	C	1300 (590)	1550 (703)
200	144	D415-200Y(Z)	C	C	1650 (748)	1875 (851)
300	216	D415-300Y(Z)	C	D	1750 (794)	2200 (998)
400	288	D415-400Y(Z)	D	D	2075 (941)	2450 (1111)
500	359	D415-500Y(Z)	D	D	2350 (1066)	2600 (1179)
600	431	D415-600Y(Z)	E	E	2575 (1308)	2800 (1270)
700	503	D415-700Y(Z)	E	E	2750 (1247)	3200 (1452)
800	575	D415-800Y(Z)	E	E	3100 (1406)	3550 (1610)

INPUT: 480 Volts

Correction rate approx. 20 volts/sec.

AMPS	KVA	MODEL	CABINET Y	CABINET YZ	WEIGHT Y lb. (kg)	WEIGHT YZ lb. (kg)
40	33	D480-40Y(Z)	A	B	500 (227)	650 (295)
60	50	D480-60Y(Z)	A	B	600 (272)	800 (363)
100	83	D480-100Y(Z)	B	B	800 (363)	1100 (499)
150	125	D480-150Y(Z)	B	C	1000 (454)	1450 (658)
200	166	D480-200Y(Z)	C	C	1140 (517)	1675 (760)
300	249	D480-300Y(Z)	C	D	1500 (680)	2000 (907)
400	333	D480-400Y(Z)	D	D	1900 (862)	2300 (1043)
500	416	D480-500Y(Z)	D	E	2200 (998)	2600 (1179)
600	499	D480-600Y(Z)	E	E	2700 (1300)	3600 (1633)
700	582	D480-700Y(Z)	E	E	2950 (1338)	3800 (1724)
800	665	D480-800Y(Z)	E	E	3800 (1724)	4100 (1860)

Sizes and weights are subject to change. If sizes and weights are critical, request drawing from factory.

TYPICAL APPLICATIONS

AC Induction Motors — A small imbalance in phase voltage will cause greatly increased currents to flow through the windings of the motor, resulting in increased heating and loss of motor life. A PAVR with individual phase control will ensure an overall phase balance within ±1%, reducing maintenance and replacement costs.

Lighting — All types of lighting equipment are voltage sensitive. Incandescent bulbs are particularly vulnerable to voltage fluctuations, with a 5% increase in voltage resulting in a 40% decrease in bulb life. Application of a PAVR can result in significant savings in bulb replacement costs, particularly if used to operate bulbs at a reduced voltage.

Automated Production Equipment — Voltage sags and surges can cause automated equipment to malfunction resulting in loss of production.

High-Rise Buildings — The PAVR is an economical alternative to oversizing cable in long runs through large building complexes. Initial cost of several regulators to compensate for cable voltage drop is often much less than over-cabling and the voltage is more consistently maintained. Savings are also realized because related equipment, such as circuit breakers and fuses, need not be oversized for increased fault current levels.

Broadcast Industry — The PAVR is used extensively throughout the commercial broadcast industry to provide stable voltage to high power UHF-TV and other types of transmitters. It is also used to regulate incoming voltage to production studios and sound stages.

Shore-to-Ship Power — Portable substations utilizing custom high voltage PAVRs have been provided to supply the quality power necessary to reliably operate sophisticated on-board electronics while ships are in port or undergoing test and/or repairs. These can be supplied at any primary voltage up to 13.8 kV and at power levels up to 5 MVA, for any application. Distribution step-down transformers, switchgear, instrumentation, fuses, protective relays, etc., can be provided as part of the package.

X-Ray & Medical Electronics — Maintaining proper incoming line voltage to many types of medical imaging equipment is crucial to obtaining consistently usable exposures. PAVRs are used to provide stable voltage to X-ray, CT, MR, and DMR installations and are particularly useful in mobile applications, where the quality of the power feed to the van or trailer is often questionable. The increasing sophistication of other types of medical electronics demands that attention be paid to line voltage quality if errors and inaccuracies are to be avoided. The PAVR is well suited for many such applications.

HOW TO ORDER A VOLTAGE REGULATOR

CORRECTION RATE

The correction rate of a regulator is the rate at which the regulator can correct for a line voltage variation. Know if your application requires a regulator to correct instantly (within several cycles), or if you can use a less expensive, less complicated, and more efficient, electro-mechanical regulator like the PAVR that corrects in seconds. Why buy more than your application requires?

INPUT VOLTAGE RANGE

The input voltage range of a regulator is the input voltage variation that the regulator can correct for. It is usually expressed as a percentage of the nominal voltage rating of the regulator, i.e., ±10% or ±20%.

VOLTAGE, PHASE, FREQUENCY, & POWER

Know the nominal voltage, single or three phase, the frequency, and the power required.

OPTIONS

Several options are available. The more common options are:

- Individual phase control for three-phase regulators.
- Regulator bypass switch
- Input circuit breaker
- Step-up or step-down
- Line drop compensation
- Additional metering

HEADQUARTERS - BREWSTER, NY

THE COMPANY

Hipotronics is a high technology company specializing in high voltage test equipment and high voltage power sources. Hipotronics' markets are international in scope and the company is recognized throughout the world as the preeminent force in high voltage testing equipment. Innovative design approaches and dedication to meeting the needs of industry, have lifted Hipotronics to a position of leadership in the vital areas of HV AC, HV DC and HV Impulse test systems, as well as HV DC Power Supplies of all types. Our customers cover a broad spectrum of industry, science and utilities.

FACILITIES

Hipotronics' 100,000 square-foot modern industrial complex represents a number of advanced manufacturing operations successfully merged into a production facility unique to the industry. Integration of manufacturing processes permits the purchase of basic raw materials and encourages flexible design and manufacturing alternatives throughout the product cycle. Complete facilities are available for machining and forming metals and other materials and fabricating them into the many structural devices and enclosures required for our high voltage test equipment. Among the most complete and modern in the industry, the facility includes coil winding equipment, steel cutting machinery, complete oil processing equipment, cotton serving and paper taping machinery, and a vacuum/pressure-type varnish impregnation system. Testing facilities include a high bay area, 60-feet high, with necessary clearance to assemble and test units well into the mega-volt range, a 25-ton rated capacity traversing crane that allows for easy assembly of multi-ton equipment. Complete oil processing equipment for heating and evacuating air and impurities, ensures the clean oil necessary for high voltage insulation.

Pictured above is a high voltage, high current Power Supply manufactured for a key research laboratory for use in its fusion research program. This unit incorporates our PVT (Peschel Variable Transformer) Technology and results in a system which is more cost effective and reliable than conventional methods.

THE POWER PRODUCTS DIVISION

The Power Products Division, located in Millerton, New York, specializes in the design and manufacture of high power variable and constant voltage sources, high voltage and high current DC power supplies, regulated substations, and various other voltage control products. The Millerton facility was completed in November, 1986. It contains 48,000 square feet of combined office and manufacturing space. It has been designed and constructed especially for the manufacture of PPD's specific products, resulting in a facility that incorporates the newest and best methods available for the construction of our transformer products. Also included is one of the most sophisticated testing facilities in our industry. With the opening of this new plant, Hipotronics is in an even stronger position to supply the best designed and manufactured products in our industry.

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